

-Claims-

- [1] 1. A premixed charge compression ignition (PCCI) engine to compress a premixed charge of fuel and air at a high temperature and a high pressure, and thus, induce a natural ignition of the premixed charge, the PCCI engine comprising:
- a suction port provided with a suction valve;
 - an exhaust port provided with an exhaust valve;
 - a suction manifold placed to communicate with the suction port, and provided with an injector, thus homogeneously mixing the fuel with the air therein to provide the premixed charge;
 - a cooling nozzle provided at an upper end in a combustion chamber of a cylinder;
 - a fluid feed pump to feed a cooling fluid to the cooling nozzle at a high pressure;
 - and
 - a storage tank to store the cooling fluid therein,
- wherein the cooling nozzle injects the cooling fluid into the combustion chamber at a high pressure during a compression stroke of a piston in the cylinder, thus providing a high compression ratio to induce the natural ignition of the premixed charge.
- [2] 2. The PCCI engine according to claim 1, further comprising:
- a first connecting rod part coupled at both ends thereof to the piston and a first support plate, respectively;
 - a second connecting rod part coupled at both ends thereof to a crankshaft and a second support plate, respectively; and
 - a plurality of springs to support and couple the first and second support plates to each other.
- [3] 3. The PCCI engine according to claim 1 or 2, further comprising:
- an electric igniter provided at an upper portion of the combustion chamber.
- [4] 4. A premixed charge compression ignition (PCCI) reciprocating generator having a PCCI engine structure to compress a premixed charge of fuel and air at a high temperature and a high pressure, and thus, induce a natural ignition of the premixed charge, the PCCI reciprocating generator comprising:
- a suction port provided with a suction valve;
 - an exhaust port provided with an exhaust valve;

a suction manifold placed to communicate with the suction port and provided with an injector, thus homogeneously mixing the fuel with the air therein to provide the premixed charge;

a cooling nozzle provided at an upper end in a combustion chamber of a cylinder;

a fluid feed pump to feed a cooling fluid to the cooling nozzle at a high pressure;

a storage tank to store the cooling fluid therein, so that the cooling nozzle injects the cooling fluid into the combustion chamber at a high pressure during a compression stroke of a piston in the cylinder, thus providing a high compression ratio to induce the natural ignition of the premixed charge; and

a reciprocating generator unit to generate electricity using a reciprocating force of the piston.

- [5] 5. The PCCI reciprocating generator according to claim 4, wherein the reciprocating generator unit is coupled at a first end thereof to a first connecting rod part which is coupled to the piston, and at a second end thereof to a second connecting rod part which is coupled to a crankshaft, so that work of the piston is transmitted to the reciprocating generator unit without being reduced by the crankshaft.

- [6] 6. The PCCI reciprocating generator according to claim 5, further comprising:
a first support plate coupled to the reciprocating generator unit at a position between the reciprocating generator unit and the second connecting rod part;
a second support plate coupled to the second connecting rod part at a position between the reciprocating generator unit and the second connecting rod part; and
a plurality of springs to support and couple the first and second support plates to each other.

- [7] 7. The PCCI reciprocating generator according to any one of claims 4 through 6, further comprising:

an electric igniter provided at an upper portion of the combustion chamber.

- [8] 8. A premixed charge compression ignition (PCCI) engine to compress a premixed charge of fuel and air at a high temperature and a high pressure, and thus, induce a natural ignition of the premixed charge, the PCCI engine comprising:

a combustion chamber provided at a sidewall thereof with both a suction port having a suction valve and an exhaust port having an exhaust valve;

a suction manifold coupled to the suction port and having an injector therein; and

first and second pistons respectively arranged in lower and upper parts in the combustion chamber to face each other, so that the first and second pistons reciprocate in opposite directions based on the combustion chamber.

[9]

9. The PCCI engine according to claim 8, further comprising:

a cooling nozzle provided on the sidewall of the combustion chamber;

a fluid feed pump to feed a cooling fluid to the cooling nozzle at a high pressure;

a storage tank to store the cooling fluid therein;

a temperature sensor to sense a temperature of the combustion chamber; and

a controller to control the engine so that the cooling nozzle injects the cooling fluid into the combustion chamber when the temperature of the combustion chamber sensed by the temperature sensor is not lower than a predetermined reference point.

[10]

10. The PCCI engine according to claim 8 or 9, further comprising:

first and second crankshafts respectively coupled to the first and second pistons through a mechanical manner;

first and second pulleys respectively coupled to the first and second crankshafts; and

a belt wrapped around the first and second pulleys to allow the first and second pistons to reciprocate in the opposite directions based on the combustion chamber.

[11]

11. The PCCI engine according to claim 10, further comprising:

a first connecting rod part coupled at both ends thereof to the first piston and a first support plate, respectively;

a second connecting rod part coupled at both ends thereof to the first crankshaft and a second support plate, respectively;

a plurality of first springs to support and couple the first and second support plates to each other;

a third connecting rod part coupled at both ends thereof to the second piston and a third support plate, respectively;

a fourth connecting rod part coupled at both ends thereof to the second crankshaft and a fourth support plate, respectively; and

a plurality of second springs to support and couple the third and fourth support plates to each other.

[12]

12. The PCCI engine according to claim 8 or 9, further comprising:

an electric igniter provided on the sidewall of the combustion chamber.

- [13] 13. A premixed charge compression-ignition (PCCI) reciprocating generator having a PCCI engine structure to compress a premixed charge of fuel and air at a high temperature and a high pressure, and thus, induce a natural ignition of the premixed charge, the PCCI reciprocating generator comprising:
a combustion chamber provided at a sidewall thereof with both a suction port having a suction valve and an exhaust port having an exhaust valve;
a suction manifold coupled to the suction port and having an injector therein;
first and second pistons respectively arranged in lower and upper parts in the combustion chamber to face each other, so that the first and second pistons reciprocate in opposite directions based on the combustion chamber; and
first and second reciprocating generator units to generate electricity using reciprocating forces of the first and second pistons, respectively.
- [14] 14. The PCCI reciprocating generator according to claim 13, further comprising:
a cooling nozzle provided on the sidewall of the combustion chamber;
a fluid feed pump to feed a cooling fluid to the cooling nozzle at a high pressure;
a storage tank to store the cooling fluid therein;
a temperature sensor to sense a temperature of the combustion chamber; and
a controller to control the generator so that the cooling nozzle injects the cooling fluid into the combustion chamber when the temperature of the combustion chamber sensed by the temperature sensor is not lower than a predetermined reference point.
- [15] 15. The PCCI reciprocating generator according to claim 13 or 14, further comprising:
first and second crankshafts respectively coupled to the first and second pistons through a mechanical manner;
first and second pulleys respectively coupled to the first and second crankshafts; and
a belt wrapped around the first and second pulleys to allow the first and second pistons to reciprocate in the opposite directions based on the combustion chamber.
- [16] 16. The PCCI reciprocating generator according to claim 15, wherein the first reciprocating generator unit is coupled at a first end thereof to a first connecting rod part which is coupled to the first piston, and at a second end thereof to a second connecting rod part which is coupled to the first crankshaft, and

the second reciprocating generator unit is coupled at a first end thereof to a third connecting rod part which is coupled to the second piston, and at a second end thereof to a fourth connecting rod part which is coupled to the second crankshaft.

[17]

17. The PCCI reciprocating generator according to claim 16, further comprising:
a first support plate coupled to the second end of the first reciprocating generator unit;

a second support plate coupled to the second connecting rod part;

a plurality of first springs to support and couple the first and second support plates to each other;

a third support plate coupled to the second end of the second reciprocating generator unit;

a fourth support plate coupled to the fourth connecting rod part; and

a plurality of second springs to support and couple the third and fourth support plates to each other.

[18]

18. The PCCI reciprocating generator according to claim 13 or 14, further comprising:

an electric igniter provided on the sidewall of the combustion chamber.